problem that the outermost shape of the liquid crystal display module MDL becomes larger at the side accommodating the fluorescent tube than at the opposite side. Especially in a high resolution liquid crystal display element, the terminal pitch is so reduced as to make it necessary to arrange the drive ICs at the two opposed sides and to lead out the terminals of the video signal lines to the two sides. In this case, especially the wiring area of the lamp cables LPC have to be uniformly reduced as much as possible with respect to the aforementioned two sides.

Brief Summary Text (22):
A seventh object of the present invention is to reduce the outermost shape of a liquid crystal display device by arranging the wiring area of a lamp cable LPC in an area uniformly as small as possible for the two opposed sides.

Brief Summary Text (30):
Moreover, electronic parts mounted only one side at the portion of the multi-layered flexible substrate, this portion is composed of two or more conductor layers, and the electronic parts are positioned in an opening of a shield casing.

Brief Summary Text (34):
In order to achieve the aforementioned second object, according to the present invention, there is provided a liquid crystal display device, wherein the multi-layered flexible substrate includes a pad pattern portion for packaging parts, via holes for electric connections, and a surface conductor layer formed of a solid or mesh-shaped pattern portion fixed at a DC power supply voltage, such as 5 volt or at the ground.

Brief Summary Text (35):
Alternatively, there is provided a liquid crystal display device, wherein a first substrate is made of the multi-layered flexible substrate including a pad pattern portion for packaging parts, via holes for electric connections, and a surface conductor layer formed of a solid or mesh-shaped pattern portion fixed at the ground, wherein a second substrate is made of the multi-layered wiring substrate for a display data controller and a power supply unit including electric connecting via holes, a surface conductor layer formed of a solid or mesh-shaped pattern portion fixed at the ground, and a surface conductor layer of an opposite side, having electronic parts mounted on the side, and wherein the surface conductor layers of the first substrate and the second substrate, having their solid or mesh-shaped pattern portions fixed at the ground, are connected electrically with the ground pads of a common metallic shield casing.

Brief Summary Text (36):
In order to achieve the above-specified third object, a plurality of multi-layered flexible substrates for peripheral circuits have their wiring lines electrically connected with each other through a metallic wiring pattern on the transparent insulating substrate.

Brief Summary Text (43):
In order to achieve the above-specified seventh object, according to the present invention, there is provided a liquid crystal display device comprising: a liquid crystal display element having two superposed transparent insulating substrates confining a liquid crystal inbetween; and a side light type back light for illuminating the liquid crystal display element from the back, wherein the fluorescent tube of the back line has its lamp cable guided along the outer periphery in parallel with the four sides of the liquid crystal display element below and inside the liquid crystal display element.

Brief Summary Text (44):
Alternatively, there is provided a liquid crystal display device comprising: a liquid crystal display element having two superposed transparent insulating substrates confining a liquid crystal inbetween; and a side light type back light for illuminating the liquid crystal display element from the back, wherein the fluorescent tube of the back line has its lamp cable guided along the outer periphery in parallel with the four sides of the liquid crystal display element below and inside the liquid crystal display element, such that the cable for a higher voltage side is positioned in parallel with a fluorecent tube side and is led out to a connector for an inverter

in a shorter way and whereas the cable for a lower voltage side is positioned in parallel with the remaining three sides of said liquid crystal display element and is led out to a connector for an inverter in a longer way, wherein both said cables are accommodated in groove portions of a lower casing.

Brief Summary Text (45):
According to the present invention, the peripheral driver has its wiring substrate made of the multi-layered flexible substrate so that the wiring density can be enhanced while allowing the folding to take an advantage in the size reduction. Moreover, the ground pattern of the conductor layer fixed at a DC voltage can be formed over the surface layer to take an advantage for counter-measures against the EMI. Still moreover, the multi-layered flexible substrate is used in place of the TCP to make the joiner unnecessary between the peripheral circuit boards and the liquid crystal panel so that the parts number of the liquid crystal display device, such as the TCP can be reduced.

Brief Summary Text (52):
According to the present invention, the lamp cable of the slender fluorescent tube is arranged around the four sides in the space below the multi-layered flexible substrate packaged in the outer periphery of the liquid crystal display element, so that it can be accommodated by using the space efficiently. As a result, the device can have its external size reduced to reduce its size and weight.

Drawing Description Text (5):
FIG. 4 presents a top plan view, a front side, a rear side, a right side and a left side of a shield casing SHD;

Drawing Description Text (20):
FIG. 19 presents a top plan view, a front side, a rear side, a right side and a left side of a lower casing MCA;

Drawing Description Text (21):
FIG. 20A is a section taken along line A--A of the assembled liquid crystal display module of FIG. 2 and shows the positional relations among the shield casing, the folded portion of the multi-layered flexible substrate, the mounted driver ICs, the rubber cushion, the back light and the lower casing, and FIG. 20B is a section taken along line B--B of the assembled liquid crystal display module of FIG. 2 and shows the positional relation of a lamp cable and other parts;

Drawing Description Text (22):
FIG. 21 is a block diagram showing an equivalent circuit of a TFT liquid crystal display module according to the present embodiment;

Drawing Description Text (23):
FIG. 22 is a diagram showing an equivalent circuit of one dot of the TFT liquid crystal display panel shown in FIG. 21;

Drawing Description Text (24):
FIG. 23 is a diagram showing the capacitors which are connected with the individual gate signal lines of the equivalent circuit of one pixel of the TFT liquid crystal display panel shown in FIG. 21;

Drawing Description Text (25):
FIG. 24 is a top plan view showing the construction of the gate lines and drain lines and the periphery of the line lead-out portion of the TFT liquid crystal display panel of the present embodiment;

Drawing Description Text (26):
FIG. 25 is a block diagram showing the schematic construction of the individual drivers of the TFT liquid crystal display module of the present embodiment and the flows of signals;

Drawing Description Text (27):
FIG. 26 is a diagram illustrating the levels and waveforms of a common voltage to be applied to a common electrode, a drain voltage to be applied to a drain electrode, and

a gate voltage to be applied to a gate electrode in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (28):
FIG. 27 is a diagram showing the flows of the display data and clock signals from the display controller to the gates and the drain driver in the TFT liquid crystal display module in the present embodiment;

Drawing Description Text (29):
FIG. 28 is a diagram illustrating the corresponding relations between the input display data and the red, green and blue dots in two pixels in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (32):
FIG. 31 is a timing chart of the display data to be inputted from a host computer to the display controller and the signals to be outputted from the display controller to the gate and drain drive ICs in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (36):
FIG. 35 is a diagram showing the connecting portion between the display control integrated circuit element TCON and an interface I/F1 at the Host side in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (37):
FIG. 36 is a diagram showing the connecting portion between the display control integrated circuit element TCON and the interface I/F1 at the Host side in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (38):
FIG. 37 is a diagram showing the connecting portion between the signals inputted to and outputted from the gate drive ICs and the input signals from the drain driver substrate in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (39):
FIG. 38 is a diagram showing the connecting portion between the signals to be inputted to and outputted from the gate drive ICs and the signals to be inputted from the drain driver substrate in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (40):
FIG. 39 is a diagram showing the connecting portion between an interface I/F4 and the signals to. be inputted to the drain drive IC and of the outputs from the drain drive IC in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (41):
FIG. 40 is a diagram showing the connecting portion between an interface I/F4 and the signals to be inputted to the drain drive IC and of the outputs from the drain drive IC in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (42):
FIG. 41 is a diagram showing the connecting portion between an interface I/F4 and the signals to be inputted to the drain drive IC and of the outputs from the drain drive IC and the outputs to the gate driver substrate in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (43):
FIG. 42 is a diagram showing the connecting portion between an interface I/F5 and the signals to be inputted to the drain drive IC and of the outputs from the drain drive IC in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (44):
FIG. 43 is a diagram showing the connecting portion between an interface I/F5 and the signals to be inputted to the drain drive IC and of the outputs from the drain drive IC and the outputs to the gate driver substrate in the TFT liquid crystal display module of the present embodiment;

Drawing Description Text (46):
FIG. 45 is a diagram showing the connecting portion between the input interface at the host side and the output interface to the drain driver substrate in the TFT liquid crystal display module of the present embodiment, and a circuit construction of the actual liquid crystal driver .

Detailed Description Text (3):
Reference letters SHD designate a shield casing (or metal frame) made of a metal sheet; letters WD a display window; characters SPC1 to SPC4 insulating spacers; characters FPC1 to FPC3 folded multi-layered flexible circuit boards (of which characters FPC1 designate the circuit board at the gate side, and characters FPC2 and FPC3 designate the circuit boards at the drain side); letters PCB an interface circuit board; letters ASB a circuit board assembly integrated with the liquid crystal display panel PNL; letters PNL a liquid crystal display element having drive ICs mounted on one of two superposed transparent insulating substrates; characters GC1 and GC2 rubber cushions; letters PRS a prism sheet; letters SPS a diffusive sheet; letters GLB a light guide plate; letters RFS a reflective sheet; letters MCA a lower casing (or mold casing) formed by an integral molding; letters LP a fluorescent tube; letters LPC lamp cables; letters LCT a connector for an inverter; and letters GB rubber bushes for supporting the fluorescent tube LP. These components are stacked in the shown vertical arrangement to assemble the liquid crystal display module MDL.

Detailed Description Text (5):
The module MDL is composed of two kinds of mounting/holding members of the lower casing MCA and the shield casing SHD.

Detailed Description Text (6):
Letters HLD designate four mounting holes for mounting the module MDL as the display block in the data processing device such as the personal computer or word processor. The lower casing MCA is formed with mounting holes MH1 to MH4, and the shield casing SHD is also formed with mounting holes SH1 to SH4 which are aligned to the mounting holes MH1 to MH4 (as shown in FIGS. 4 and 19). The liquid crystal display. device is fixed and mounted to the data processing device by fastening screws into the mounting holes of the two. The module MDL is equipped with a brightness adjusting volume VR, and the inverter for the back light is arranged in the MI portion so that the power is supplied to the back light BL through the connector LCT and the lamp cables LPC. The signals from the host computer (or host) and the necessary power are supplied to the controller and the power supply unit of the liquid crystal display module MDL through an interface connector CT positioned at the back of the module.

Detailed Description Text (7):
FIG. 3 is a block diagram showing the TFT liquid crystal display element of the TFT liquid crystal display module according to the embodiment of FIG. 1 and the circuits arranged around the TFT liquid crystal display element. In the present invention, although not shown, drain drivers IC1 to ICM and gate drivers IC1 to ICN are chip-on-glass packaged (i.e., COG packaged) by connecting these drivers to drain side lead-out lines DTM and gate side lead-out lines GTM formed over one transparent insulating substrate of the liquid crystal display element through an anisotropic conductive film or an ultraviolet hardening resin. In the present embodiment, the liquid crystal display element has effective dots of 1,024.times.3.times.768 according to the XGA specifications. As a result, the transparent insulating substrate of the liquid crystal display element is COG-packaged with eight drain drive ICs having 192 outputs at each of the longer sides (M=16) and eight gate drive ICs having 100 outputs at each shorter side (N=8). The liquid crystal display element is arranged with drain driver units 103 at its upper and lower sides, a gate driver unit 104 at its one side, and a controller unit 101 and a power supply unit 102 at its other side. These controller unit 101, power supply unit 102, drain driver unit 103 and gate driver unit 104 are individually connected to one another by electric joint means JN1 to JN4.

Detailed Description Text (9):
<<Metallic Shield Casing SHD>>FIG. 4 presents the upper side, front side, rear side, right side and left side of the shield casing SHD, and a perspective view, as taken obliquely from above the shield casing SHD, is shown in FIG. 1.

(at 5.V) and the power supply Vdg. Moreover, the drain side FPC2 and FPC3 are soldered, as shown in FIGS. 39 to 43, such that the substrate FPC2 is soldered at totally ten portions C21 to C30 between the ground potential Vss and a power sup ply Vdd (at 5 V) or between the ground potential Vss and a power supply Vdp (at 2.5 V) whereas the substrate FPC3 is soldered at totally ten portions C31 to C40. These capacitors CHG and CHD are provided to reduce the noise to be superposed on the power supply line. Incidentally, in order to enhance the soldering accuracy, small holes FAL can be formed in the substrates FPC1 to FPC3 to mount the chip capacitors automatically over the substrates.

Detailed Description Text (41):
The present embodiment is so designed that those chip capacitors are soldered to only the surface conductor layer L1 at one side and are all located at the side of the shield casing SHD, after folded, to take planarly common portions with the openings SHL of the shield casing SHD. As a result, the power noise smoothing capacitors can be mounted on the substrates FPC1 to FPC3 while retaining the thickness of the liquid crystal module MDL constant.

Detailed Description Text (43):
Since the metal shield casing SHD is located at the surface side of the liquid crystal module MDL and at the front side of the data processing device, the EMI (electromagnetic interference) noise from that side will cause serious problems in the circumstance of using the external devices.

Detailed Description Text (45):
Moreover, the patterns FGP, in which the pattern ERH is exposed from the solder resist SRS, are arranged at two portions in the gate side substrate FPC1 and at four portions individually in the drain side substrates FPC2 and FPC3 and are soldered to the FGF ground of the shield casing SHD thereby to reduce the EMI noises. In case the peripheral circuit is divided into a plurality of substrates, as in the present embodiment, no electric problem will arise in a DC manner if at least one portion of the driver substrate is connected with the frame ground. In the high-frequency region, on the contrary, if the grounded portions are less, the potential for generating the unnecessary radiation waves to cause the EMI is caused by the reflection of the electric signals or by the shaking of the potential of the ground wiring lines due to the difference in the characteristic impedance of the individual driver substrates. Especially the active matrix type module MDL using the thin film transistors is difficult to eliminate the EMI because it uses a high-speed clock. In order to prevent this difficulty, in at least one portion of each circuit substrate, the ground wiring line (at the AC ground potential) is connected with the common frame (i.e., the shield casing SHD) having a sufficiently low impedance. As a result, the ground wiring lines are strengthened in the high-frequency region, so that the radiation electric field intensity is drastically improved in the case of the present embodiment having the ten portions connected than in case only one portion is connected with the shield casing SHD.

Detailed Description Text (50):
All the electronic parts are mounted on the lower side of the substrate PCB or the back side, as viewed from the data processing device. Two integrated circuit elements TCON are arranged as the display controller at the right and left sides of the substrate. The interface connector CT is located at the central portion of the substrate, on which are further mounted a plurality of resistors and capacitors. The brightness adjusting volume VR can have its knob portion adjusted from the outside through the hole CVL of the shield casing SHD, which is planarly in the same position as the hole PVL of the substrate PCB, as described hereinbefore.

Detailed Description Text (57):
The substrate PCB has its upper side located at the surface side, as viewed from the data processing device, that is, in the direction to have the highest potential for irradiating the EMI noises. In the present embodiment, therefore, the top surface conductor layer is coated substantially all over its surface with the ground solid or mesh-shaped pattern ERH, as shown in FIG. 11C. FIG. 14B is an enlarged front elevation of the pattern ERH. The mesh- shaped pattern ERH of a copper conductor below the solder resist SRS is coated all over its surface excepting the via holes VIA. This pattern ERH is enabled to reduce the EMI noise radiation by soldering the lower side

pattern FGP of the substrate PCB and the FGN ground of the shield casing SHD.

Detailed Description Text (71):
These electric connection patterns JN3 and JN4 are formed simultaneously with the pixel pattern of the liquid crystal panel PNL. In the present embodiment, the pattern JN3 is composed of four wiring lines (as shown in FIG. 37) which are arranged to have gradually lower voltages of Vdg (of 10 V), Vsg (of 5 V), CL3 (of the gate scanning clock) and Vss (of the ground) inward from the frame periphery of the substrate SUB1. Incidentally, the gate scanning clock CL3 (as shown in FIG. 31) is a low-frequency clock pulse having its level changing between 5 to 10 V for one horizontal period of about 20 sec (about 50 KHz). The pattern JN4 is also composed of four wiring lines (as shown in FIG. 38) which are arranged to have gradually smaller absolute voltages of Vee (of -17 V), Veg (of the gate-off voltage), FLM (of the frame start indicating signal) and Vss (of the ground) inward from the frame periphery. The voltage Veg (as shown in FIG. 26) is a low-frequency clock pulse having its level changing between -17 to -11 V for two horizontal periods (of about 25 KHz). The voltage FLM (as shown in FIG. 31) is a low-frequency pulse having its level changing between 5 to 10 V for a period of 60 Hz. Thus, these AC signals raise no problem as the EMI noises because they have the low frequencies.

Detailed Description Text (76):
The rubber cushion GC1 is sandwiched, as shown in FIG. 20A and 20B, between the flexible substrate FPC on the frame periphery of the substrate SUB1 of the display panel PNL and the lower case MCA. As a result, the pressure is applied to fix the two or less conductor layers' portions FSL to improve the connection reliability of the substrate SUB1 with the input wiring pattern. Moreover, the rubber cushions take the role of preventing the drive ICs from being mechanically damaged by contacting with the lower casing MCA.

Detailed Description Text (77):
The rubber cushion GC2 is sandwiched between the substrate SUB2 of the display panel PNL and the reflective sheet LS or the light guide plate GLB. By pushing the shield casing SHD into the device while using the elasticity of the rubber cushion GC2, the fixing hooks HK are caught by the fixing projections HP. Then, the fixing pawls NL are folded and inserted into the fixing recesses NR so that these fixing members function as stoppers to fix the shield casing SHD and the lower casing MCA. As a result, the module is firmly held in its entirety while requiring no other fixing members. Thus, the assembling can be facilitated to reduce the production cost. Moreover, the device can have its mechanical strength and its anti-vibration/impact enhanced to improve the reliability. Incidentally, the rubber cushions GC1 and GC2 have their one sides wetted with an adhesive and are adhered to predetermined portions of the flexible substrate FPC and the substrate SUB2.

Detailed Description Text (80):
The side light type back light BL for illuminating the display panel PNL from the back is composed of the one cold-cathode fluorescent tube LP, the lamp cable LPC of the fluorescent tube LP, the rubber bush GB for retaining the fluorescent tube LP and the lamp cable LPC, the light guide plate GLB, the diffusive sheet SPS arranged in contact with the whole surface of the light guide plate GLB, the reflective sheet RFS arranged over the bottom face of the light guide plate GLB, and the prism sheet PRS arranged in contact with the whole surface of the diffusive sheet SPS.

Detailed Description Text (89):
<<Lower Casing MCA>>

Detailed Description Text (90):
FIG. 19 presents the top plan, upper side, rear side, right side and left side of the lower casing MCA.

Detailed Description Text (91):
The lower casing MCA, as molded is a back light accommodating casing, i.e., a holding member for the fluorescent tube LP, the lamp cable LPC, the light guide plate GLB and so on, as shown in FIG. 1, and is monolithically molded of a synthetic resin by one mold. The lower casing MCA is firmly united with the metallic shield casing SHD by the actions of the individual fixing members and elastic members so that the module MDL

can have its vibratory impulse resistance and thermal impulse resistance improved to improve the reliability.

Detailed Description Text (92):
The lower casing MCA is formed, in its bottom face at the central portion excepting the peripheral frame portion, with a large opening MO occupying a half or more area of the bottom face. As a result, after the module MDL has been assembled, the lower casing MCA can be prevented, by the repulsive force of the rubber cushion GC2 (of FIG. 20) between the liquid crystal display panel PNL and the light guide plate, from having its bottom face bulged by the vertical force applied downward to the bottom face of the lower casing MCA, thereby to suppress the maximum thickness. This makes it unnecessary to increase the thickness of the lower casing so as to suppress the bulging, so that the lower casing can be made thin to reduce the thickness and weight of the module MDL.

Detailed Description Text (93):
Letters MCL designate a notch (including the notch for connecting the connector CT, as shown in FIG. 11), which is so formed in the lower casing MCA as to correspond to the exothermic parts of the interface circuit board PCB, i.e., a packaged portion such as the hybrid IC power source circuit (e.g., a DC--DC converter) in the present embodiment. Thus, the heat liberation of the exothermic portions of the interface circuit board PCB can be improved not by covering the exothermic portion of the circuit board PCB with the lower casing MCA but by forming that notch. Specifically, at present, the multiple gray-scales and the single power source are demanded for improving the performance and the facility of the liquid crystal display device using the thin film transistors TFT. The circuit for realizing these demands consumes a high power. If the circuit means is to be packaged in compact, the packaging becomes so highly dense to raise the problem of the heat generation. As a result, the dense packaging and the compactness of the circuit can be improved by forming the lower casing MCA with the notch MCL corresponding to the exothermic portions. On the other hand, the signal source integrated circuit TCON is also considered as the exothermic parts, above which the lower casing MCA may be notched.

Detailed Description Text (94):
Letters MH1 to MH4 designate four mounting holes for mounting that module MDL in the appliance such as a personal computer. The metallic shield casing SHD is also formed with the mounting holes SH1 to SH4 aligned with the mounting holes MH1 to MH4 of the lower casing MCA, so that it can be fixed and packaged in the appliance.

Detailed Description Text (95):
The rubber bush GB retaining the fluorescent tube LP and the lamp cable LPC is fitted in an accommodating portion MG formed so, and the fluorescent tube LP is accommodated out of contact with the lower casing MCA in an accommodating portion ML.

Detailed Description Text (96):
Letters MB designate a retaining portion of the light guide plate GLB, and letters PJ designate a positioning portion. Letters ML designate an accommodating portion for the fluorescent tube LP; letters MG designate an accommodating portion of the rubber bush GB; and letters MVX designate a groove portion for fitting the overlapped portions of the reflective sheet LS and the light guide plate GLB around the fluorescent tube LP. Characters MC1 designate an accommodating portion for the lamp cable LPC1, and characters MC2 designate an accommodating portion for the lamp cable LPC2.

Detailed Description Text (97):
<<Accommodation of Lamp Cable LPC in Lower Casing MCA>>

Detailed Description Text (98):
In the present embodiment, the wiring of the lamp cable LPC is devised to make a compact packaging and to eliminate the adverse effects upon the EMI noises.

Detailed Description Text (100):
Specifically, of the two lamp cables LPC, the cable LPC2 at the ground voltage side is so accommodated in the accommodating portion MC2 grooved in the lower casing MCA as to follow the external shapes of the, at least, three sides other than the accommodating portion of the fluorescent tube LP. The higher voltage side cable LPC1 is wired

shortly close to the portion connected with an inverter IV and is accommodated in a grooved accommodating portion MC1. As a result, only the ground voltage wiring lines take a long path so that the adverse effects upon the EMI noises are unchanged from the prior art. As a result, no lamp cable LPC2 is present at the side of the fluorescent tube LP, as shown in FIG. 20A, to reduce the wiring area by 1.5 to 2 mm, as compared with the case in which the two lamp cables LPC1 and LPC2 are led out from one side. In the present embodiment, as shown in FIG. 20B, the lamp cable LPC2 is arranged inside of the transparent insulating substrate SUB1 and just below the drive IC thereby to make a compact design. In case the drain drivers are led out at the two sides, this wiring method is especially proper for the compact liquid crystal module.

Detailed Description Text (101):
With the leading end portions of the lamp cables LPC1 and LPC2, there is connected the inverter IV. This inverter IV is accommodated in its accommodating portion MI. In case the module MDL is thus assembled in an appliance such as the personal computer, neither the lamp cable LPC runs along the outer sides of the module, nor protrudes the inverter IV to the outside of the module MDL. As a result, the back light BL can have its fluorescent tube LP, lamp cable LPC, rubber bush GB and inverter IV accommodated and packaged in compact to reduce the size and weight of the module MDL thereby to lower the production cost.

Detailed Description Text (105):
First of all, the TFT liquid crystal display module of the present embodiment will be summarized in the following.

Detailed Description Text (106):
FIG. 21 is a block diagram showing the TFT liquid crystal display panel and the circuits arranged around the former. The drain driver unit 103 is arranged at the top and bottom sides of the TFT liquid crystal display panel (TFT-LCD), and the gate driver unit 104, and the controller unit 101 and the power supply unit 102 are arranged at the right and left sides of the liquid crystal display panel (TFT-LCD) which has the XGA specifications composed of 1,024.times.3.times.768 dots.

Detailed Description Text (109):
FIG. 22 is a diagram showing an equivalent circuit of the TFT liquid crystal display panel (TFT-LCD) of FIG. 21.

Detailed Description Text (116):
In the equivalent circuit of one pixel of the TFT liquid crystal display panel (TFT-LCD) of FIG. 22, there are stray capacitors Cgd and Cgs between the drain and gate and between the gate and source of the thin-film transistor TFT.

Detailed Description Text (120):
Moreover, since no gate signal line is present outside of the final gate signal line (G768), the capacities of the capacitors to be connected between the gate signal lines of G768 and G769 can be different from the capacities between the other gate signal lines (G1 to G768). In the TFT liquid crystal display module of the present embodiment, therefore, the dummy gate signal line (G769) is disposed outside of the final gate signal line (G768) so as to equalize the capacities of the capacitors to be connected with the gate signal lines.

Detailed Description Text (126):
FIG. 25 is a block diagram showing the schematic construction and signal flows of the drivers (i.e., the drain driver, gate driver and common driver) in the TFT liquid crystal display module of the present embodiment.

Detailed Description Text (131):
FIG. 27 is a diagram showing the flows of display data and clock signals for the gate driver 206 and the drain driver 211 in the TFT liquid crystal display module of the present embodiment. On the other hand, FIG. 32 is a timing chart showing the display data to be inputted from the host computer to the display controller 201, and the signals to be outputted from the display controller 201 to the drain and gate drivers.

Detailed Description Text (138):

The least significant input display data RA0, BA0 and GA0 are connected with the RFRC, BFRC and GFRC of the display control integrated circuit element TCON so that they are used as the inputs for the frame rate control (as will be shortly referred to as "FRC"). This FRC method is an existing technique in the simple matrix liquid crystal for displaying in multiple colors by controlling the display data for each designated frame and by controlling the effective value to be applied to a liquid crystal cell Clc. An example, as applied to the TFT liquid crystal, is disclosed in "Multi-Color Display Control Method for TFT-LCD", SID 91 DIGEST, 547(1991) by Hiroyuki Mano, Tsutomu Furuhashi, and Toshio Tanaka et al.

Detailed Description Text (141):
While thus premising the sixty four gray-scale display or the one hundred twenty eight gray-scale display of the FRC method for each color, the TFT liquid crystal display module of the present embodiment is constructed such that the display data sent from the host computer are inputted by 7 bits or 6 bits for each color and such that the drain driver can process 6 bits for each color. This display controller is constructed to have its input and output pixel numbers equalized so that the period (DCLK) of the input clock and the output period (CL2) are identical. Moreover, the input data received are outputted, if it is not necessary to process these input data, to the drain driver.

Detailed Description Text (152):
In case the display controller 201 is located at the master side, the master mode terminal takes the High level whereas the slave mode terminal takes the Low level, so that the data polarity signal is actually used as it is in the circuit and is inputted as the clock to the logic processor 227. Moreover, the data polarity signal is inputted from the output buffer through an output pad PAD to the display controller 201 at the slave side so that it acts as the synchronizing signal.

Detailed Description Text (153):
In case the display controller 201 is at the slave side, the master mode terminal takes the Low level whereas the slave mode terminal takes the High level so that the output buffer does not act any more. In this state, the data polarity signal coming from the master side output buffer through the output pad PAD is applied as an input to the PAD of the slave side display controller 201. This data polarity signal from the master side is actually used as it is in the circuit and is inputted as the clock of the logic processor 227 of the slave side display controller 201. As a result, the output clocks do not go out of phase between the two display controllers.

Detailed Description Text (155):
The data polarity signal, as fed from the master side output buffer through the output pad PAD, is transmitted from the terminal DDT to the terminal DDT of the slave side input pad PAD.

Detailed Description Text (170):
(2) The multi-layered flexible substrate has its surface conductor layer covered with the solid or mesh- shaped pattern portion fixed at a DC power supply voltage, such as 5 volt or at the ground. As a result, it is possible to provide a data processing device which has a liquid crystal display device having a low EMI level and an excellent environmental resistance, even if the pixel number and the display color number are increased to raise the frequencies of the necessary signals.

Detailed Description Text (176):
(8) The lamp cable for the slender fluorescent tube is arranged around the four sides in the space below the multi-layered flexible substrate mounted in the outer periphery of the liquid crystal display element, so that the lamp cable can be accommodated by using the space efficiently. As a result, the device can have its external shape reduced to a small size and a light weight.

CLAIMS:

1. A liquid crystal display device comprising: a liquid crystal display element having two superposed transparent insulating substrates confining a liquid crystal inbetween; and a side light type back light for illuminating said liquid crystal display element from the back, wherein a fluorescent tube of said back light has a lamp cable guided

along the outer periphery in parallel with the four sides of said liquid crystal display element below said liquid crystal display element.

2. A liquid crystal display device according to claim 1, wherein the lamp cable does not extend beyond the outer periphery of said liquid crystal display element.

3. A liquid crystal display device comprising: a liquid crystal display element having two superposed transparent insulating substrates confining a liquid crystal inbetween; and a side light type back light for illuminating said liquid crystal display element from the back, wherein a fluorescent tube of said back light has a lamp cable guided along the outer periphery in parallel with the four sides of said liquid crystal display element below said liquid crystal display element, the lamp cable including a cable for a higher voltage side and a cable for a lower voltage side such that the cable for a higher voltage side is positioned in parallel with the fluorecent tube side and is led out to a connector for an inverter in a shorter way and whereas the cable for a lower voltage side is positioned in parallel with the remaining three sides of said liquid crystal display element and is led out to a connector for an inverter in a longer way, wherein both said cables are accommodated in groove portions of a lower casing.

4. A liquid crystal display device according to claim 3, wherein the lamp cable does not extend

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L11: Entry 1 of 2 File: USPT Nov 17, 1998

DOCUMENT-IDENTIFIER: US 5838400 A
TITLE: Liquid crystal display device with reduced frame portion surrounding display area

Abstract Text (1):
A liquid crystal device in which a peripheral circuit board positioned in the outer periphery of a seal port is recessed to avoid the projection of the seal port and in which a fluorescent tube has its two lamp cables arranged around the four sides of a crystal display element, so that the substrate at the seal port side and the lamp cable of a side light type back light can be packaged in compact.

Brief Summary Text (6):
The active matrix type liquid crystal display device of the prior art is constructed in the liquid crystal display element (i.e. the liquid crystal display panel) which is formed with thin-film transistors (TFT) and which has a liquid crystal sealed, by connecting drive ICs (or driver ICs) for driving the liquid crystal display element as the tape carrier package (TCP) mounted on a tape carrier, with vertical scanning lines and horizontal signal lines through an anisotropic conductive film (or anisotropic connector), by wiring peripheral circuits, which are used to generate and transmit liquid crystal display data necessary for the drive ICs and timing signals to the individual drive ICs, in a printed board, and by arranging the peripheral circuits around the tape carrier package (TCP) and soldering the same to the tape carrier package (TCP).

Brief Summary Text (9):
The liquid crystal display device of the prior art uses a printed board in a peripheral circuit board, and the signals to be inputted to each pixel are connected from the printed board through the cables or the TCP with the liquid crystal display element. With an increase in the pixel number, therefore, the liquid crystal display device of the prior art increases the number of connections between the liquid crystal display element and the TCP so that it is troubled by a problem that the probability of electric connection failure increases. With an increase in the display color number, moreover, the data line number of the display data has a tendency to increase, together with the enlargement of the outermost shape of the liquid crystal display device, thereby to raise a problem that the external size of a data processor, such as a personal computer or word processor having the liquid crystal display device assembled is enlarged.

Brief Summary Text (11):
Moreover, the liquid crystal display device of the prior art uses a printed board as the substrate for the display data controller and the power supply unit or as the peripheral driver substrate for horizontal and vertical scannings, and the signals and the power supply between the substrates are electrically connected with a joiner, such as a flat cable. With an increase in the display color number of the liquid crystal display device, therefore, the number of wiring lines necessary in a limited area of the joiner is increased to make it necessary to connect the narrow pitch highly reliably and efficiently.

Brief Summary Text (15):
In the liquid crystal display device of the prior art, moreover, in a side light type back light for irradiating the liquid crystal display element from the back, two lamp cables LPC of a fluorescent tube LP are led out from the outer periphery which is in parallel with the side for accommodating the fluorescent tube LP. This raises a